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Abstract

SPACE-TIME CORRELATION RELATIONS IN MULTIPLYING SYSTEMS

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The paper includes some theoretical and experimental results of investigating space-time correlation functions of a reactor assembly. An interest toward such investigations is due on the one hand to the necessity to consider the character of the approximation of the already developed reactor noise theory which does not take into account the space localization of the detector. On the second hand theoretical investigation of neutron density as a random function of time and space co-ordinates permits one to introduce into the theory some reactor parameters which are not included in the elementary theory. Therefore it becomes possible to measure these parameters.

The paper defines a correlation function

$$M(\vec{r}_1, \vec{r}_2, t) = \langle m(\vec{r}_1, 0)m(\vec{r}_2, t) \rangle - \langle m(\vec{r}_1, 0) \rangle \langle m(\vec{r}_2, t) \rangle,$$

where $m(\vec{r}, t)$ is the number of neutrons at time t inside volume v around point $\vec{r}$. By using a diffusion-age approximation specific results were obtained for homogeneous infinite multiplying subcritical media with isotropic scattering. Knowledge of the form of the correlation function permits one to determine all fundamental stochastic properties of multiplying and detection processes including spectral power density of the given correlation function, the autocorrelation function of detector counting rate, fluctuation of the number of neutrons in a reactor cell.

An experimental investigation was undertaken of the correlation between fluctuations of neutron flux detected by two ionization chambers inside a reactor. The chambers could be brought together or removed away from each other.

Experimental results indicate that when the two detectors move away from each other the correlation between the fluctuation components of neutron flux, measured by the chambers, diminishes.

Comparison of experimental data and theory permits one to obtain information concerning space features of the reactor system (migration length, etc.).